

EINHORN (M.)

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AZOBENZOL,

OR TOEPFER'S TEST FOR FREE
HYDROCHLORIC ACID.

BY
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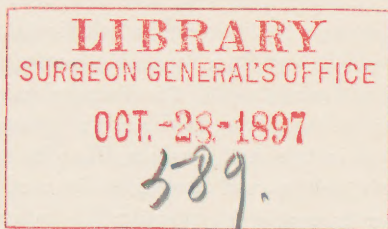
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THE DIMETHYLAMIDOAZOBENZOL,
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By MAX EINHORN, M. D.

I SHOULD like to speak of something to-day which in a measure forms an advance in gastric analysis. Eight years ago I presented to you most reactions which serve the purpose of detecting free hydrochloric acid in the gastric contents. At that time I mentioned that Günzburg's reaction marked an advance in so far as by means of it it was possible to prove the presence of a mineral acid, a test which does not apply to any of the organic acids. In regard to this point, no better reaction until now has been found. Recently, however, Toepfer† suggested the new reaction, by means of which it is possible to determine the presence and amount of free hydrochloric acid. The substance which Toepfer used is called dimethylamidoazobenzol, and it was introduced into acidimetric analysis by Fischer and Philips. Toepfer first used it for testing the gastric contents. Dimethylamidoazobenzol colors a solu-

* Read before the German Medical Society of New York, September, 1895, with demonstrations.

† Toepfer. *Zeitschrift für physiologische Chemie*, Bd. xix, Heft 1.

tion containing traces of free acid red. This reagent is best used as a half-per-cent. alcoholic solution, and the test made as follows: To a few cubic centimetres of the gastric filtrate add one drop of the dimethylamidoazobenzol solution; if it turns red, free acid is present. Filter paper saturated in this half-per-cent. Toepfer solution and dried becomes yellow, and may also be used for ascertaining whether free acid is present; the paper turns red when the latter is present. The sensitiveness of the paper, however, is far less than that of the Toepfer solution. The sensitiveness of Toepfer's reagent is very great. While Günzburg's test reveals one twentieth per mille of HCl, Toepfer's solution shows the presence of even one fortieth per mille of HCl—*i. e.*, this reaction is twice as sharp as Günzburg's. Toepfer stated that dimethylamidoazobenzol responds to free HCl and not to the combined hydrochloric acid, and that it gives no reaction with small quantities of organic acid, especially when albuminates are present. Thus, according to Toepfer, lactic acid in quantities amounting to less than one half of one per cent. does not give rise to this reaction; he therefore recommends dimethylamidoazobenzol as a very delicate and convenient test for the qualitative and quantitative determination of free hydrochloric acid in the gastric contents. Friedenwald,* of Baltimore, has corroborated Toepfer's statements in every particular, and anew warmly advocated this procedure. In order to ascertain the value of Toepfer's reagent I have made the following experiments:

A. 1. A one-per-cent. peptone solution containing 0.05 per cent. of lactic acid was mixed with one drop of Toepfer's solution; it turned yellow.

2. A one-per-cent. peptone solution containing 0.1 per cent. of lactic acid turned red when Toepfer's solution

* Friedenwald, J. *Medical Record*, April 6, 1895.

was added; the red color remained even after it was twice diluted with water.

3. A one-half-per-cent. peptone solution containing 0.05 per cent. of lactic acid turned slightly red with Toepfer's solution; when it was diluted three times with water the red color remained.

4. A watery solution containing 0.12 per cent. of hydrochloric acid diluted forty times became intensely red with Toepfer's reagent; when diluted fifty times it became very slightly red.

5. A one-per-cent. peptone solution to which hydrochloric acid had been added, so that it contained 0.012 per cent. of it, gave with Toepfer's solution a yellow color.

6. A one-half-per-cent. peptone solution containing the same amount of HCl gave also a yellow color.

7. A one-quarter-per-cent. peptone solution containing 0.012 per cent. of HCl gave with Toepfer's solution a very slightly red color.

8. A one-per-cent. peptone solution to which hydrochloric acid had been added, so that it contained 0.024 per cent. of it, gave with Toepfer's solution a yellow color.

9. A one half per-cent. peptone solution containing the same amount of HCl became slightly red with Toepfer's solution.

10. A one-half-per-cent. peptone solution containing 0.024 per cent. of HCl, when titrated with a one-tenth standard solution of sodium hydrate and Toepfer's reagent as indicator, showed a degree of acidity of eight (for one hundred of the peptone solution).

11. A one-per cent. peptone solution to which HCl had been added, so that it contained 0.06 per cent. of it, gave with Toepfer's solution a red color, and showed on titration with it a degree of acidity of sixteen.

The same solution titrated with phenolphthalein as indicator revealed a degree of acidity of thirty-six.

12. A one-per-cent. peptone solution (Witte's) titrated with phenolphthalein showed a degree of acidity of six.

Experiments with Gastric Filtrates.—B. 1. Filtrate of patient K. one hour after the test breakfast: $\text{HCl} = 0$, acidity = 20, lactic acid = 0, biuret + intensely.

This filtrate gives with Toepfer's solution no reaction.

To four cubic centimetres of the filtrate is added one cubic centimetre of a one-per cent. watery solution of lactic acid: Examined with Toepfer's solution, equals red color; examined with Günzburg's, equals no reaction; examined with Uffelmann's, equals canary yellow—*i. e.*, the test for lactic acid positively responds.

The same filtrate containing 0.2 per cent. of lactic acid, diluted with water ten times and examined with Toepfer's solution, gives a *red color*.

2. The gastric filtrate of David F. H., obtained an hour after a test breakfast: $\text{HCl} = 0$; lactic acid + (Uffelmann); acidity = 40.

The filtrate gives no reaction with Toepfer's solution.

To nine cubic centimetres of the filtrate, one cubic centimetre of a one-per-cent. lactic-acid solution is added: with Toepfer's solution equals red coloration with an orange tinge.

The same diluted ten times with water gives with Toepfer's solution a red color.

From these experiments it is apparent that Toepfer's reagent is by far more sensitive than Günzburg's solution. The latter reveals the presence of HCl up to 1 to 20,000, while Toepfer's reagent may disclose HCl when present in 1 to 40,000 or even 50,000 (experiment 4). Toepfer's assertion that combined HCl does not respond to his test is found verified in experiments 5, 6, and 8.

But with regard to lactic acid, I find that my results differ from those of Toepfer and Friedenwald. Both writers state that lactic acid responds to this test only when present in half a per cent. and above. Experiments 2 and 3 (A) show that lactic acid, if present in 0.1 per cent. even in solutions containing peptones, responds to Toepfer's reagent. The experiments with gastric filtrates to which lactic acid has been added (under B) again clearly show that one tenth of one per cent. of lactic acid gives a characteristic red color reaction with Toepfer's solution.

These experiments, therefore, justify the conclusion that qualitatively the presence of free HCl can be positively proved only by Günzburg's test, and that Toepfer's solution is not sufficiently certain, for organic acids may give the same reaction. If, however, free HCl has been found by Günzburg's test and lactic acid found absent (Uffelmann's test), then Toepfer's reagent is an excellent means of determining the amount of free HCl. The total acidity and the amount of free HCl can then be determined at once in the following manner: To five cubic centimetres of the filtrate add one drop of a one-per-cent. phenolphthalein solution and one drop of a half-per-cent. solution of dimethylamidoazobenzol; then add one tenth standard sodium hydrate solution until the red color disappears and the solution turns yellow (the number of cubic centimetres of soda used, multiplied by twenty, gives the figure of free HCl); then continue to add of the soda solution until there appears a red color (the total number of cubic centimetres of soda used, multiplied by twenty, gives the figure of the total acidity).

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